On account of the differences in the physical condition of the country above indicated, its fauna correspondingly varies ; and, according to Mr. Blanford, five zoological sub-regions may be defined with tolerable accuracy. Each of these deserves brief reference upon the present occasion. The first is that of the Persian plateau or highland, which forms by far the greatest and most characteristic part of the country. Although this district, and all the others except the last, are Palæarctic in their nature, nevertheless several types characteristic of the desert tracts of North Africa and Central Asia are included, such as the genera *Gazella, Gerbillus, Dipus, Gyps,* and *Buteo.*

The second sub-region is that of the Caspian provinces Ghilan and Mazandaran, which form the forest-covered, humid southern shore of the Caspian Sea. The fauna is almost identical with that of South-east Europe. The tiger is found there, however, and a Deer (*Cervus caspius*) closely allied to the Axis Deer of India, as well as a Pit-viper (*Halyx*).

The third sub-region is that of the wooded slopes of the Zagros, running from Shiraz, as a strip, in a north-westerly direction. It differs, as far as is known of it, but little from the last, with which it may be confluent. The lion inhabits it, as well as a new species of Woodpecker (*Picus sancti-johannis*). The fourth sub-region is that of Persian Mesopotamia, which is the eastern portion of the Tigris plain. It closely resembles Syria in fauna. The last is that of Baluchistan and the shores of the Persian Gulf, which differs greatly from the rest of Persia, Indian or Indo-African forms prevailing.

Mr. Blanford enumerates eighty-nine species of mammals, three hundred and eighty-three of birds, ninety-two of reptiles, and nine of amphibia, as found in Persia ; and he mentions as a general characteristic of the fauna, that the specimens are paler in colour than their European allies. This paleness frequently makes it difficult to decide whether the species are new or only varieties of those already known. In some cases, however, as, for instance, that of the Persian Badger, the author tells us that he would not have proposed a new name for it had not the skull, when compared with a series of skulls of *M. taxus,* presented decided differences.

The number of fresh species determined by Mr. Blanford and others from the collection made by Major St. John round Shiraz between 1869 and 1871, and by both these naturalists in their journey through Baluchistan and Southern Persia, is too large to be enumerated here. Of new genera Mr. Dobson determined the Phyllorrhine Bat (*Triaenops persicus*), with its very complicated nose-leaf and peculiar third alar digit, in 1872 ; and Mr. Blanford has, from an exhaustive study of the reptiles, made the genera *Bunopus, Ceramodactylus, Agamura,* and *Zygnopsis.* Curiously, no crocodiles are known to occur in the country, though they are common in the neighbourhood of Sind, and are to be found in Palestine ; their absence is associated with the inconstancy of the supply of water in the small rivers. The Agamoids and Lacertians are much more abundant than the Geckos and Scincids.

Of the placental mammals the Quadrumana, Proboscidea, Hyracoidea, and Edentata, are the orders which are not represented in Persia. Bats are not numerous, as far as species are concerned. Of Insec-

tivores another species of hedgehog is described and figured. *Vulpes persicus* is the name given to a fresh Fox, and *Meles canescens* to the Pale Badger above mentioned. Among the Rodentia several new species have been discovered, including a squirrel, a dormouse, a mouse, two jumping-rabbits, a jerboa, and a hare. No specimen of the male of the new *Gazella fuscifrons* was obtained, although Major St. John, in his narrative, tells us that he lost the only one he saw from his cartridge missing fire.

Of new birds we find a Woodpecker (*Picus sancti-johannis*), a Robin (*Erythacus hyrcanus*), a Warbler (*Sylvia rubescens*), a Sun-bird (*Nectarinia brevirostris*), a Nuthatch (*Sitta rupicola*), a Tit (*Parus phaeonotus*), as well as a second (*P. persicus*), and a Jay (*Garrulus hyrcanus*). Besides the new genera of reptiles above mentioned, there are many fresh species, the descriptions of all of which, as of the mammals and birds, are accompanied by excellent figures from the pencil of Mr. Keulemanns or the late Mr. G. H. Ford, whose recent death will be felt as a great loss to naturalists generally and students of the Reptilia especially, because of the extreme care which he was always accustomed to take in the accurate delineation of the most minute detail.

What will strike the readers of the work before us most forcibly is the great pains which Mr. Blanford has taken in the accurate determination of the species he describes, and the trouble he has put himself to—by a reference to the original types—in whatever part of Europe they may be—to insure their correct identification. In many cases he has been able to give his measurements from unskinned specimens, and in several instances among the birds he has recorded the essential lengths of a large number of specimens. As an instance of this may be taken the case of *Hypolais pallida* and its allies, in which a lengthy series of measurements is given to show the complete gradation between that species, *H. rama* and *H. caligata,* forms whose specific identity is based upon slight differences in size only.

In the geological section of the volume no complete account of the geology of Persia is attempted, but Mr. Blanford adds his own experience to that of Messrs. Loftus, Bell, Grewingk, Carter, and others.

In concluding this brief notice of the valuable work before us, we feel that it is only by a detailed perusal of its contents that its value in a geographical, zoological, geological, and political point of view can be fully appreciated.

SUMNER'S "METHOD AT SEA"

Tables for Facilitating Sumner's Method at Sea. By Sir William Thomson, D.C.L., LL.D., F.R.S., Professor of Natural Philosophy in the University of Glasgow, and Fellow of St. Peter's College, Cambridge. (London : Taylor and Francis, 1876.)

THE reforms which Sir William Thomson has effected or suggested in the art of navigation are neither few nor unimportant. His invention of deep-sea sounding by pianoforte wire, and his improvements in the construction of the mariner's compass, are specimens of what he has done in the instrumental part of the subject. In the book now before us he again comes forward as a

nautical reformer, this time in another section of the field, that, namely, which treats of the calculations following on the astronomical observations of the sun or stars, which form part of the daily routine work of every navigator. Innocent as the title of the book appears, the general adoption of the method which it advocates would amount to little short of a revolution in nautical practice—a revolution which is urgently needed, and which would unquestionably be of immense advantage to sailors in more ways than one.

When an observer takes the altitude of the sun or of a star at a known instant of Greenwich mean time, he learns two things. His knowledge of the time, when brought to bear upon the information which he finds in his nautical almanac, tells him that the sun or star was vertically overhead at a certain known point on the earth's surface at the time of the sight. His knowledge of the altitude tells him that the ship was at the same time somewhere on an imaginary circle drawn on the earth's surface, the centre of which is the point where the sun or star was vertically overhead, and which lies at an angular distance from this centre (measured on the terrestrial globe) equal to the complement of the altitude. On what part of this imaginary line he is, his sight does not tell him, but he can easily make a guess to within sixty miles or so. If, then, he can draw a portion of this circle, short enough to be taken without sensible error as a straight line, in that part of his working chart in which he knows his ship to be, he will have obtained from his sight all the information which that one sight can give him, and no more. This is so very obvious, that it seems strange that no one should have pointed it out before 1843. Nevertheless, it appears to be the case that Capt. Thomas H. Sumner, of Boston, Mass., was the first to do so, and to publish a practical method of drawing the line we have spoken of. The circle on any part of which the ship may be is now commonly called a Sumner circle of equal altitude, for from every point in it the altitude of the body observed is the same at the time of the sight. The short straight portion of it which in practice is drawn on the working chart, is called a Sumner line.

To illustrate the drawing of Sumner circles we cannot, perhaps, do better than quote the example given in the preface to Sir William Thomson's book :—

"Suppose that the altitude of the sun's centre was observed to be 50° at 1h. 17m. 48s. P.M., Greenwich mean time, on the 27th August, 1874. From the *Nautical Almanac* we learn that the sun 'southed' at Greenwich at 11h. 57m. 48s. A.M. on that day, therefore at the instant of the observation he was due south of a place one hour and twenty minutes in time, or twenty degrees in angle west of Greenwich. His declination at the time of the sight was 10° N. Hence he was overhead in lat. 10° N., long. 20° W. If one point of a pair of compasses be put on this point on a globe representing the earth, and a circle be drawn by the other point running at 40° (that being the zenith distance or complement of the altitude) from this point, this circle will be such that at any point on its circumference the altitude of the sun was 50° at the instant of the observation. The chart given below shows this circle drawn on Mercator's projection, which, of course, draws out the north and south parts and prevents it from appearing like a true circle. The circle corresponding to the example just given is the eastmost one on the chart.

"Suppose now that 2h. 40m. later the altitude of the

sun is again taken and found to be 40°. At the moment of this second observation the ship was somewhere on the other circle, the westmost of the two given on the chart. What we learn from the two observations, then, is
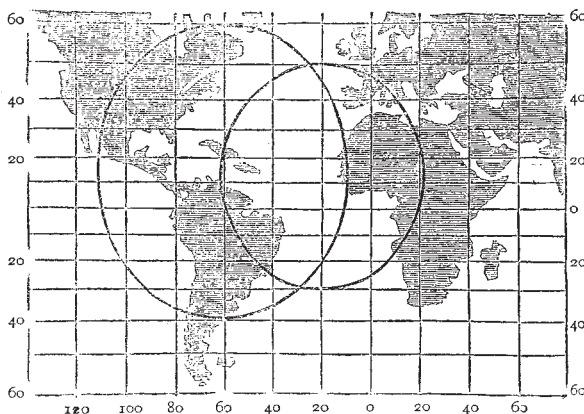
that at the time of the first observation the ship was somewhere on the circle to the right, and at the time of the second observation she was somewhere on the circle to the left. If, therefore, she did not change her place between the two observations, she must have been at one or other of the two points in which the circles intersect."

It is, of course, as impracticable as it is unnecessary to draw the whole of the Sumner circle corresponding to each observation. Sumner's method may be defined as any practical method by which the short straight portion called a Sumner line can be drawn. This may be done in either of two ways. Here, again, we may quote Sir W. Thomson :—

"Every part of the Sumner circle is perpendicular to the true bearing of the body observed, and therefore the azimuth of the body observed is equal to the angle which the Sumner line makes with the parallels of latitude. Hence, if we know the latitude and longitude of one point in the Sumner line, and also the true azimuth of the body observed, we are able to draw the line on the chart. This brings us to the consideration of practical methods of drawing the Sumner line for an observation. Let the latitude be estimated to (say) the nearest degree, and let the longitude be calculated corresponding to this latitude. This gives us the latitude and longitude of one point on the Sumner line. Next calculate the true azimuth of the body observed at the time of the sight. Then through the point draw a line making an angle with the parallels of latitude equal to the true azimuth, and so as to be perpendicular to the true bearing of the body. The line so drawn is the Sumner line, and all that any one sight tells us is that the ship is somewhere upon it.

"It is, however, more usual to calculate the longitude of two points on the Sumner line corresponding to two estimated latitudes, differing by half a degree or more, and then to draw on the chart the line passing through the two points so determined. This last is the plan given by Captain Sumner."

Each of these plans is a little tedious, for each involves two distinct calculations. But since the Sumner line is really the only true statement of what any sight tells, we might expect that, spite of its tediousness, Sumner's method would be found in general use. Unfortunately it is not so. The usual practice among sailors is not to work out every sight independently, but to complicate the conditions of the problem by the introduction of some new element in order to shorten the work of calculation. Sum-

ner's method gives, as we have seen, a line on which the ship is, and in doing so it gives us all the information which any one sight can yield. But if we possess some other information, such as a knowledge of the true latitude, the position becomes completely determinate ; each condition gives a locus, and the intersection of the two loci gives a point. By introducing this foreign element into the calculation of the original sight, we may obtain at once the definite information that the ship is in a certain latitude and longitude, and we may do so by a single calculation. This is the practice of ninety-nine navigators out of a hundred, but it is a practice much to be deprecated. It makes the sailor imagine that a knowledge of the latitude, got either by dead reckoning or by taking a meridian altitude, is necessary in order that he may get any information at all out of a single observation of altitude and time. If he trusts to obtaining this knowledge by dead reckoning he is likely enough to estimate the latitude wrongly, and by so doing to vitiate the whole calculation. If he trusts to observing the meridian altitude, he is often disappointed by the sun's being clouded over at noon. Many a captain has lost his ship through not knowing how to avail himself (by Sumner's method) of the information which he might have derived from a short glimpse of the sun on a cloudy day. Another danger in the ordinary practice is that it tempts the navigator not to work out each sight as soon as it has been taken, for he must often wait until he is able to obtain the other information, without which he is helpless. But when Sumner's method is used, every sight tells its own tale, and there is no reason whatever why it should not tell it at once.

The limits of a review do not admit of our describing the manner in which Sir William Thomson has contrived to facilitate Sumner's method. A full explanation of how it has been done will be found in the preface to his book. At first sight it appeared that, in order that tables might be of any use, they would require to contain the solutions of 157,464,000,000 spherical triangles, to calculate which, at the rate of 1,000 per day, would take 400,000 years. This did not seem promising, but Sir William Thomson was not dismayed. He soon saw that by dividing the problem into the solution of two right-angled spherical triangles he could give all the required information in a table containing the solutions of only 8,100 triangles. These 8,100 calculations have been made under the superintendence of Mr. E. Roberts, of the *Nautical Almanac* Office, and the results are tabulated in the volume before us. Full instructions for their use are appended, along with some auxiliary tables which add greatly to the completeness of the work. Not to go into details, we may say that by an admirable application of the *second* of the two plans given above for drawing the Sumner line, the author has so shortened the time required to reduce an observation, as to convert what was formerly an objection to Sumner's method into a positive recommendation, and so has deprived sailors of their only possible excuse for not adopting it universally.

Such a general adoption, besides its direct benefits in increasing the safety of ships and men at sea, could not fail to have a great indirect effect for good in assisting the sailor to a clear perception of the fundamental principles underlying the processes which he daily employs, too often, we fear, in blind routine. A seaman using

Sumner's method can hardly help understanding what he is about, but he may work for a lifetime with the hackneyed formulæ in common use, and have no notion from first to last of why he should add a quantity rather than subtract it, or indeed of why he should deal with it at all. We have heard of a captain who used a *plus* instead of a *minus* sign for two or three weeks, and first suspected that something must be wrong when he found himself on a coral reef hundreds of miles off his supposed course. When a landsman with a smattering of mathematics goes to sea and is admitted to the privacy of the chart-room, his wonder is, not so much that some ships are lost, as that any ships escape.

It is not the masters or the mates that are chiefly to blame for this state of things. Before they enter the service their utmost immediate ambition is to get the needed certificate of competency from the Board of Trade, and they naturally study only to pass the required examination. Then afterwards their professional life is not exactly that calm repose which conduces to progress in a scientific knowledge of their art. There are no doubt exceptional men whose love of their profession is so strong as to override the barriers of circumstance. Such men deserve all praise, but we can hardly blame the rest. For a remedy we must look not to the individual officer but to the authorities who have the making of him. It is strange that the Board of Trade should not have seen it to be a duty to let no British seaman obtain its certificate without showing himself to be thoroughly acquainted with Sumner's method. Until the Board does this it will be mainly, we might say almost wholly, responsible for the prevailing neglect of this method.

The position of the nautical reformer seems to us to be anything but enviable. His virtue is perhaps its own reward, certainly he seldom meets with any other. The Board of Trade and the Admiralty will have none of him, and he cannot make much way against the conservatism bred of ignorance that he finds elsewhere. It is still fresh in the memory of every one how Mr. Plimsoll at last compelled a reluctant government to take legislative action on behalf of seamen. Unfortunately, Sir William Thomson must confine himself to milder methods : he has no opportunity of shaking his fist in the face of a prime minister.

OUR BOOK SHELF

Botanical Tables for the Use of Students. Compiled by Edward B. Aveling, B.Sc. Second Edition. (London : Hamilton, Adams, and Co.).

ANY attempt to compress the facts of nature within the arbitrary limits of a defined tabular statement must necessarily be misleading from a scientific, that is, from a philogenetic, point of view. Classificatory tables have nevertheless their use to the student, in aiding his memory by bringing a large number of facts within a small compass. Dr. Aveling is careful to disavow any independent value for his tables, and frankly states that they will not only be useless, but positively injurious, if allowed in any way to be a substitute for practical field-work. With these limitations the tables may be recommended as probably as good, or nearly so, as any that could be drawn up. They have been compiled carefully, and on the whole successfully. Defects can no doubt be pointed out. Thus the description of certain inflorescences as " centripetal arranged centrifugally " requires a foot-note to explain its